We claim:

Claim 1: A sensor for characterizing a fluid composition, the sensor comprising a plurality of mechanical resonators in combination, the plurality of resonators being adapted for measuring physical or chemical properties of the fluid composition.

Claim 2: The sensor of claim 1 wherein the plurality of resonators have different structure, different resonance frequencies and combinations thereof.

Claim 3: The sensor of claim 2 wherein the plurality of resonators comprise different coatings functionalities or combinations thereof.

Claim 4: The sensor of claim 3 wherein the plurality of resonators are selected from a low frequency tuning fork resonator, a high frequency tuning fork frequency resonator, a trident tuning fork resonator, a length extension resonator, a torsion resonator, a thickness shear mode resonator, membrane oscillators, bimorphs, unimorphs, surface acoustic wave devices, and combinations thereof.

Claim 5: The sensor of claim 4, wherein the resonators within the array are simultaneously operated in different modes of oscillation selected from self-oscillating, excited by the sweep generator, operated in free decay mode, and combinations thereof.

Claim 6: The sensor of claim 5 further comprising a measurement circuit coupled with the resonators, said measurement circuit having a signal generator for generating a variable frequency input signal to cause the resonators to oscillate, a receiver coupled to the measurement circuit to output a frequency response of the resonators, a receiver coupled to the measurement circuit to output free decay response of the resonator, a self-oscillating unit in a feedback loop with the said resonators to cause the resonators to oscillate, a gain control unit for keeping the amplitude of oscillation at a constant level, a pulse generator that provides shock excitation to the said resonator and combinations thereof.

Claim 7: The sensor of claim 2 wherein the plurality of resonators comprise a tuning fork resonator and a thickness shear mode resonator.

Claim 8: The sensor of claim 2 wherein the plurality of resonators comprise a low frequency tuning fork resonator and a high frequency tuning fork frequency resonator.

Claim 9: The sensor of claim 3 wherein the plurality of resonators have the same structure.

Claim 10: The sensor of claims 3 wherein the plurality of resonators comprise different functionalities, each of the functionalities designed to bond with a different target molecule.

Claim 11: The sensor of claim 3 wherein the plurality of resonators comprise tuning fork resonators functionalized with a polymer layer or other selective absorbing layer to detect the presence of specific molecules in a vapor.

Claim 12: The sensor of claim 3 wherein the plurality of resonators comprise functionalized tuning fork resonators adapted to detect the presence of a specific chemical in a fluid composition.

Claim 13: The sensor of claim 3 wherein the plurality of resonators are tuning fork resonators treated with a functionality that changes the resonance frequency of the tuning fork upon exposure to a selected target chemical.

Claim 14: The sensor of claim 3 wherein the plurality of resonators are tuning fork resonators covered with receptor molecules that bond with specific target molecules.

Claim 15: The sensor of claim 3 wherein the plurality of resonators are tuning fork resonators functionalized with a material that physically changes when exposed to molecules of a selected chemical, such that the mechanical drag on the tuning fork changes upon exposure to the selected chemical.

Claim 16: The sensor of claim 3 wherein the plurality of resonators are tuning fork resonators comprising hydrophobic or hydrophilic functionality.

Claim 17: The sensor of claim 4 wherein the signal generator is adapted for generating an input signal at a frequency of less than 1 MHz.

Claim 18: The sensor of claim 6 wherein the plurality of resonators are attached together by a common base.

Claim 19: The sensor of claim 6 wherein the plurality of resonators are attached to multiple frequency generating circuits adapted to measure properties of the fluid compositions over multiple frequency sweeps.